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CRITICAL EXAMINATION OF ONE HUNDRED PAINTERS FOR EVIDENCES OF LEAD POISONING.

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At the request of Dr. Alice Hamilton, of the United States Department of Commerce and Labor, I undertook the examination of 100 able-bodied painters, based upon (1) complete family, personal, and occupational history, (2) chief symptomatic and industrial complaints, (3) physical examination, and (4) certain significant tests, with the view of establishing the prevalence of plumbism or its after-effects among them. The source of material was from a large Chicago painters' union, whose officials for some years past had been giving considerable attention to morbidity and mortality statistics among their members.

These workmen may be said to constitute the hightest type of such tradesmen to be found in Chicago as regards intelligence, industry and thrift, trade application, morality, personal hygiene, and general interest in personal and community welfare. A large percentage were of foreign extraction, rearing, and trade apprenticeship. According to the statements of these, they had used very little lead paint before coming to America, zinc being the principal foreign substitute.

The examinations were made in the six weeks' period between February 22 and April 4, 1913. By an arrangement with the men and their officials the candidates came at stated hours to the examiner's office. Each case required about one hour's time, the examination of blood-smears and the analysis of the urine for lead being completed outside of this time. It may be stated that these examinations were made at the end of the winter's slack season, consequently all the men examined should have exhibited the minimal immediate effects of plumbism. The men were not taken from a sick list, but from these who attended the weekly meetings or were present at the business headquarters of the union.

CASE HISTORIES.

AGE.

Between 20 and 25 years	7	men.
Between 26 and 30 years	14	"
Between 31 and 40 years	26	"
Between 41 and 50 years	33	"
Between 51 and 60 years	17	"
Over 60 years (62, 67, 68)	3	"
Total	100	"

PARTICULAR TRADE PROCESSES.

General painters, many doing some paperhanging	63	men.
Interior painters and decorators, some paperhanging	32	"
Exterior painters exclusively	2	"
Carriage painter exclusively	1	"
Paperhangers, doing some painting	2	"
Total	100	

NATIONALITIES.

Scandinavian born	51	men.
German born	9	"
American born	20	"
Hebrews (mostly foreign born)	9	"
Miscellaneous foreign born	11	"
Total	100	"

TIME AT TRADE.

Two men had begun the trade at the ages of thirty and thirty-one. (With these exceptions all had begun as youths)

Less than 5 years at the trade	1	man.
Between 5 and 10 years at the trade	17	men.
Between 11 and 20 years at the trade	32	"
Between 21 and 30 years at the trade	28	"
Between 31 and 40 years at the trade	17	"
Between 41 and 50 years at the trade	4	"
For 54 years at the trade	1	man.
Total	100	men.

BEGAN THE TRADE.

United States of America	48	men.
Abroad	41	"
Not ascertained	11	"
Total	100	"

Father's Occupation that of Painting in 15 cases.

Significant Family History. The age of parents, cause of death, father's occupation, number of brothers and sisters, with cause of and age at death, were inquired into in all cases. While allowing for the unreliability of laymen's statements, still the following was deduced concerning parents, brothers, and sisters;

Tuberculosis	100 inquiries,	8 positive,	4 questionable
Cancer	75 "	0 "	
Insanity and epilepsy	70 "	5 "	2 questionable

Significant Personal History.

No previous diseases (other than venereal and not including probable instances of lead poisoning)	53 cases.
Suggestive evidence of plumbism in the past based upon:	
(*a*) Physician's diagnosis	10 "
(*b*) Paralyses: both wrists	1 "
both legs	1 "
(*c*) Appendicitis (1 questionable)	2 "
(*d*) Encephalopathy (epileptiform seizures, delirium or unconsciousness without fever or other diseases than probable plumbism) (2 others questionable and 1 further, which was undoubtedly due to methyl alcohol.)	3 "
(*e*) The "lead triad" (abdominal colic, obstinate constipation, severe headache without fever, with or without vomiting, all of these coming in "spells" or attacks lasting a couple of days or more and without other assignable cause) (2 others questionable.)	32 "
(*f*) "Rheumatism" (as lumbago, sciatica, pleurodynia, brachialgia, etc.), excluding cases of rheumatic fever, nerve traumatism, etc.	51 "
(*g*) Statements as to previous existence of lead-line in gums were discarded as unreliable.	
(*h*) Negative evidence of any of the above conditions	27 "
(*i*) Positive evidence of one or more of the above conditions	73 "
Serious accidents	24 "
Serious operations (2 appendicitis, 4 hernia)	6 "
Serious diseases:	
Typhoid	18 "
Pneumonia	11 "
Malaria	11 "
Pleurisy	8 "
Infections (2 smallpox)	3 "
Inflammatory rheumatism	4 "
Tuberculosis (1 questionable)	3 "
Bronchitis	2 "
Nephritis	1 "
Multiple lipomata	1 "
Wood-alcohol blindness (partial in 2 cases, recovery complete in 1 case)	3 "
Jaundice	1 "
Venereal diseases:	
Not ascertained	10 "
Denied	49 "
Gonorrhea	32 "
Chancroids	9 "
Syphilis (3 others questionable)	4 "

Habits. The approximate extent of the consumption of beverages, etc., was inquired into by ascertaining the number of cups or "drinks" per day. None admitted the use of habit-producing drugs, and there was no evidence of same. In the following table the term "moderate" has the following applications: in the case of tea or coffee, the use of not over four cups per day; in the case of beer, not over three glasses per day; in the case of whisky, not over two "drinks" per day.

Beverage.	None.	Occasional.	Moderate.	Excessive.
Tea	41	27	32	0
Coffee	7	7	73	13
Beer	10	34	42	14
Whiskey	22	52	20	6

I believe that these figures are fairly accurate, also that the tendency to moderation among the 100 men examined is rather better than for the average tradesmen.

Marital History.

Single (always)	24 men.
Married or widowers	76 "
Married one year or more	74 "
Wives never pregnant	11 "
Pregnancies but no living progeny	10 "
With living progeny	53 "

Statistics on miscarriages, no certain information.

Association between wives washing leaded garments and miscarriages, no certain information.

Progeny.

1 child living	14 men.
2 children living	18 "
3 " "	12 "
4 " "	5 "
5 " "	2 "
6 " "	2 "
8 " "	2 "
Total living children of 74 men, married at least 1 year	144
Average " " 74 " " 1 "	1.95

Progeny and Age of Married Men. There were 49 married men of forty years of age or over, of whom 37 had living progeny.

There were 35 married men of forty-five years of age or over, of whom 26 had living progeny, whereas 7 had had none at all. In this group 2 had a total of 28 children with 16 living. The total progeny of the group was 116 children, or an average of 3.31 each; total living progeny was 75 children, or an average of 2.14 each; this includes the two large families, without whose statistics the respective averages would be 2.67 and 1.79 each. This is certainly very low for married men of at least forty-five years of age. Analysis showed that these same 35 men with their total of 116 living and dead progeny came from families having a total of 235 offsprings. While this group of forty-five-year-old painters may have more progeny, it is not likely they will double the same, as would be necessary to equal their own ancestral average.

Just what part lead poisoning and what part various social conditions may have had to do with this decreased progeny is impossible of ascertainment.

COMPLAINTS.

(a) *Hygienic Complaints and Comments.*

Breathing lead paint dust from sandpapering	99 cases.
(Inquiry showed the men would have no objection to substituting zinc for lead)	
Sickened by turpentine in close quarters	91 "
Sickened by benzine in close quarters	70 "
Sickened by "hard-oiling," practically all cases.	

The men complain most bitterly of the effects of "hard-oiling" upon sensorium, skin, and digestive tract; less so of turpentine upon the digestive tract, sensorium, and bladder; and least of benzine upon sensorium, occasionally upon the digestive tract.

Wood alcohol has been largely displaced by denatured alcohol, according to their statements. Few men claim that they use either to any particular extent. Those who had been blinded had been performing special work, as in brewery vats, etc.

Other frequent complaints, particularly of respiratory, skin, and stomach disturbances, were: varnish removers, ammonia and lyes, fusel oil, oxalic acid, muriatic acid, acetone, amyl-acetate, creosote, naphtha, and various patented "dope" varnish-and-paint removers.

Time at noon hour: This was invariably one-half hour, although many stated that by special arrangements with their employer one hour might be had, providing an extra half-hour were added at the end of the day. Many said they would prefer this, as the half-hour noon-time was insufficient for properly washing up, eating, etc. *Working day* was eight hours (8 A.M., to 12 noon; 12.30 to 4.30 P.M.).

Washing of hands before eating: All the men questioned claimed a knowledge of the danger of lead poisoning from paint on hands. All stated they endeavored to wash hands with soap and water where possible; occasionally one carried his own soap and towels; most resorted to benzine to remove the paint, while a number claimed that they always ate their sandwiches, pie, etc., held in pieces of paper. Few gave much attention to the lips.

Mustaches: Fifty inquiries showed that these were worn constantly in 18 cases, occasionally in 7 cases, and not at all in 25 cases. Beards were not encountered. Only a few men had considered deposition of paint and dust in mustaches and the possibility of straining drinks through same as dangerous. Some considered that they protected nasal breathing; this is certainly a wrong impression.

(*b*) *Present Health Complaints.* The following list of symptoms, embracing those most commonly occurring in acute or chronic plumbism, was inquired into in the case of each of the 100 men. They may be considered as the complaints of the past few weeks or months:

Symptoms.	Severe.	Moderate.	Slight or occasional.	Total.
Loss of strength	..	12	4	16
Loss of weight	..	9	3	12
"Nervousness"	5	19	9	33
Digestive:				
Nausea	1	14	1	16
Anorexia (morning)	3	13	8	24
Foul taste	4	17	12	33
Foul breath	2	7 (?)	?	9 s.c
Salivary disturbances	2	16	?	18 s.c.
Emesis	..	6	4	10
Constipation	15	19	16	50
Diarrhea	2	8	9	19
Melenæ	..	2	3	5
Hemorrhoids	5	13	10	28
Visceralgia	9	18	16	43
Colic	..	4	3	7
Distention	8	18	9	35
Sensorial:				
Headache	17	14	19	50
Vertigo	4	19	13	36
Syncope	..	2	4	6
Insomnia	4	6	12	22
Nightmare	1	5	5	11
Depression	1	3	4	8
Confusion	..	6	2	8
Memory failing	s.c.	14	7	22
Neuromuscular:				
Neuralgia	1	3	2	6
Arthritic pains	3	10	11	24
Anesthesia and paresthesia, especially of arms	2	18	6	26
"Rheumatism"	1	18	16	35
Muscular cramps	1	12	11	24
Trembling	2	7	8	17
Ocular (especially "spots" and diplopia)	6	17	7	30
Itching eyelids	1	8	5	14
Aural (tinnitis, deafness)	4	23	13	40
Urinary (incontinence, nocturnal frequency)	7	27	4	38
Genital (impotence)	1	3	3	7
Circulatory (palpitation, epistaxis)	..	12	15	27
Festering cuts	..	1	1	2
Neurasthenic	1	5	9	15

Special symptoms associated with severe or acute plumbism, such as psychoses, paralyses, paroxysms, aphonia, etc., were not encountered.

Comments on the Above Table. So far as possible, specific causes of any of the above symptoms, other than lead poisoning, have led to the exclusion of such symptoms in the above table, that is, (1) in cases of rupture, visceralgia, constipation, and distention were omitted; (2) neuralgias due probably to teeth were omitted; (3) joint pains and "rheumatism," due to acute inflammatory rheumatism, past or present, were omitted; (4) defective vision, due to refractive errors, omitted as far as possible; (5) aural disturbances, due to otitis media, omitted so far as possible; (6) urinary disturbances were in nearly all cases due to nocturnal frequency, not to venereal diseases, and rarely to incontinence; most cases occurred in those of advancing years; only one due to diabetes.

PHYSICAL FINDINGS.

The following scheme was carried out in each of 100 cases, with abnormal findings as listed:

General:	Cases.	Remarks.
Appearances unhealthy	10	
Pallor	7	Not marked in any.
Emaciation, general	4	Not marked in any.
Emaciation, local (arms)	5	Not sought for in but 25 instances.
Prematurely aged	8	
Loss of expression	1	
Loose teeth	18	
Lead line	19	10 not pronounced.
Pyorrhea	51	Pronounced in 17.
Tremor, lips or tongue	27	
Tremor of hands	19	
Deafness	4	All rather pronounced.
Nystagmus	4	
Mydriasis	12	
Myosis	2	
Unequal pupils	4	
Argyl-Robertson pupil	2	Neither with absent knee-jerks.
Ptosis	1	
Strabismus	4	All since early childhood.
Conjunctivitis	4	Rather marked in one.
Atrophic nails	1	
Wrist tumor (no injuries)	2	1 ganglion, 1 small bone; no typical Gubler tumor.
Pulse-rate	5	All arrhythmias.
Pulse-tension	..	See blood-pressure below.
Arteriosclerosis (radial)	11	
Incoördination (arms)	17	1 well marked, 6 moderate, 10 slight.
Wrist reflexes	4	2 absent, 2 markedly increased.
Wrist paralyses	0	
Chest:		
Heart abnormal	23	Including 2 questionables.
Lungs abnormal	20	7 emphysema, 1 acute bronchitis, no pronounced tubercular lesions, although 14 were suspicious.
Mediastinum	1	Dulness with tenderness.
Abdomen:		
Enlarged liver	6	
Hernia	6	
Distention (gaseous)	7	Including 1 hernia, 1 ascites.
Superficial tenderness	0	
Deep tenderness	2	1 gall-bladder?
Operation scars	8	4 hernia, 2 appendix, 2 genital.
Abdominal reflex absent	12	
Genitalia:		
Hydrocele	2	
Undescended testicle	1	
Cremasteric reflex absent	26	
Retraction of testes	7	
Skin:		
Dryness	2	1 ichthyosis.
Dermatitis	6	Mostly wrists.
Acne	6	
Dermographia	1	Very marked.
Extremities:		
Gouty toe-joint	8	
Edema of ankles	7	6 with varicose veins.
Epitrochlear glands	2	Out of 50 examinations.
Knee-jerks abnormal	16	3 absent, 13 exaggerated.

SPECIAL TESTS.

1. *Sodium Sulphide Skin Application.* This was made in 90 cases, using a 5 per cent. solution by means of an applicator. The test usually shows positive on the hands, wrists and forearms of any who have worked in lead, particularly painters, within a week or ten days, that is, a brown or black streak resulting immediately after the application. In all of my cases the hands and arms had been washed with soap and water, in many cases for a period of over several days, since the workman's last exposure to lead paint or dust. It appears that the oil and turpentine in the paint, as well as benzine used by the men to cleanse the skin, cause the paint to infiltrate the deeper layers of the epidermis and probably the follicles and skin glands to such an extent that the normal slow exfoliation is necessary to remove it. DuMoulin's test,[1] although based upon an incorrect assumption as to its value, is an amplification of this means of proving the presence of lead. Of course, other black sulphides, as copper, mercury, bismuth, nickel, and cobalt, had to be ruled out, but usually none of these concern painters. The test demonstrates to the painter himself in a very striking manner the extent to which he is actually encased in a sheet of lead, despite his soap-and-water ablutions. Out of 62 men who reported they had worked at least an hour or more with lead paint or its dust within the previous two weeks, this test was positive on hands, wrists, and forearms in 42 instances. Continuing the applicator up the arm and down the chest to the umbilicus, 6 were positive all the way; in other words, such men were practically entirely encased in a sheet of lead buried deep in the skin. I will not attempt to enter into the discussion as to the probability of absorption from this source.

2. *Urinary Analysis.* The cursory analysis was made from a fresh specimen in each case. In addition, most of the men, in response to a special request, brought a pint bottle of urine, which, being added to that part of the fresh specimen not required for immediate tests, gave several hundred cubic centimeters for the determination of the presence of lead. Of course, twenty-four-hour specimens would have been more satisfactory, and on this account the urinary features of contracted kidneys had to be omitted. Specific gravity, color, turbidity, and reaction were first determined in each sample. Albumin was sought for by the heat and acetic acid tests and by Heller's test. Reducing bodies, by Haines' reagent, supplemented by Nylander's test when indicated. Indican by Obermayer's and Lavelle's methods preceded by the lead subacetate preparation. In the remaining urine, lead

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[1] Bull. de l'académie royale de Médecine de Belgique, 1884, p. 1093.

was sought for in 39 cases, selected as being the most promising although in all of these more urine should have been taken.

I am indebted to Dr. F. M. Meixner for the lead analyses, which were made with special equipment in the laboratory of the Cook County Hospital. Briefly stated, possible lead combinations in the urine were decomposed by adding to the specimen about one-tenth its bulk of pure nitric acid, boiling down to 60 c.c., filtering, washing residue, and the total filtrate of about 90 c.c. subjected to electrolysis in a properly covered lead-free beaker. By means of three dry cells arranged in series, connected up with a miniature rheostat, and a double-pole switch, a current of two volts at a milliampèrage of about 4 was maintained for a period of 8 hours in the solution, using platinum electrodes coiled in spiral form. The beaker was kept at 37° to 40° C. by an electric bulb. A browning or blackening of the electrode attached to the carbon pole gave presumptive evidence of lead, deposited as the peroxide, which was determined quantitatively by comparing the weight of the dried electrode before and after the electrolysis, also by colorimetry, and qualitatively by the usual methods. Three control experiments to determine delicacy of the method showed:

	Percentage recoverable		
Dilution.	Experiment 1.	Experiment 2.	Experiment 3.
1 to 100	99.8	99.7	96.0
1 to 500	99.4	99.7	96.8
1 to 1,000	99.7	99.4	97.3
1 to 5 000	95.2	92.0	90.0
1 to 10,000 (blackening of electrode but weights and therefore percentages not determined).			

The above results were obtained by using the required amount of lead salt to make the dilution in 500 c.c. water.

The more significant results of the urinary analysis in brief were as follows:

Acid reaction (usually sharp)	95 cases.
Albumin plus casts	7 "
Dextrose	1 "
Indican found to be increased	19 "
" " excessive	8 "
Lead present (0.16 and 0.11 mg.) traces (?) in some others	2 "

3. *Blood Examination.* (*a*) A blood-smear was made in each case and afterward stained by Harlow's solution.[2] These were examined for evidence of blood dyscrasias, basophilic erythrocytic degenerations, differential counts, etc. Briefly stated, no blood diseases were found and no evidence of severe anemias. There was an apparent slight leukocytosis present in 5 cases, many showed a tendency to mononucleosis, while Grawitz's

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[2] Emery R. Hayhurst, Blood-smears, their Preparation and Staining, Jour. Amer. Med., Assoc., December 4, 1909, liii, 1909 to 1911.

granulations or stippling of the red cells was not encountered in sufficient amount to be of significance. The absence of the latter was not surprising, inasmuch as no acute cases of plumbism were encountered.

(*b*) No cases of marked pallor being encountered, the hemoglobin was estimated in each case by using simply a Tallqvist scale, the results showing:

105 per cent.	4 cases.
100 "	51 "
95 "	42 "
90 "	3 "

(*c*) Liebermann's erythrocytic resistance test,[3] which, according to Orban,[4] is markedly raised in cases of plumbism (that is, during the phase of actual intoxication the red cells become resistant to hemolysis in hypotonic salt solutions), was made in 21 selected cases, 2 of which were positive (failed to show appreciable hemolysis in 0.45 per cent. NaCl solution).

4. *Strength of Hand Grip.* This was determined by a hand dynamometer of the Collin type having a graduated reading from 0 to 200 upon the "echelle de traction." The instrument was standardized by obtaining the records of 55 men pursuing all manners of trades and avocations except those of lead exposure; the low reading was invariably over 150 in the weaker hand, the majority of normal men showing a strength of 160 to 230. To get uniformity of conditions, each person was required to stand erect with both arms horizontally outstretched while the hand holding the dynamometer was rather slowly contracted to maximal power, then released. Enough tests were made in each case to be certain maximal power was attained, then the highest reading accepted, gripping alternately with each hand.

The results in painters showed weakness in grips of both hands in 41 of 95 cases. The strength of those ranged from 78 to 150; five other cases were discarded because of previous injury to the hands or arms.

These cases with weak grips showed significant associated conditions and findings as follows:

1. Age: 16 of 20 cases over fifty years of age.
2. Time at trade: 16 of 21 cases over thirty years at trade.
3. History of paralysis: 2 of 2 cases.
4. History of plumbism: 10 of 10 cases.

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[3] L. v. Liebermann and F. v. Fillinger, Ueber Resistenz der Erythrocyten bei gesunden und kranken Menschen, nebst einer einfachen Methode zu ihrer Bestimmung, Deutsch. med. Woch., 1912, xxxviii, No. 10, s. 5.

[4] Ueber gewerbliche Vergiftungen mit Bezug auf die Liebermannsche Blutprobe, Deut. med. Woch., October 31, 1912, xxxviii, No. 44, s. 3. Note also E. Schaeffer, Fehlerquellen bei Bestimmung der Resistenz der Erythrozyten nach v. Liebermann und v. Fillinger, Deutsch. med. Woch., October 3, 1912, xxxviii, No. 40, s. 2.

5. History of appendicitis: 2 of 2 cases.
6. Unhealthy appearance: 8 of 10 cases.
7. Emaciation of arms: 5 of 5 cases.
8. Inguinal hernia (past or present): 7 of 9 cases.
9. Absent abdominal reflex: 11 of 12 cases.
10. Absent knee-jerks: 3 of 3 cases.
11. Low systolic pressure: 3 of 3 cases.
12. Drop in systolic pressure after exercise: 4 of 4 cases.
13. Too great a relative proportion of the following cases was also associated with weak grips: Interior painters, Germans, Hebrews, history of encephalopathy, father a painter, alcoholics, loss of strength, loss of weight, anorexia, bad taste, salivary disturbance, distension of abdomen, headaches, vertigo, syncope, insomnia, confusion, poor memory, muscular cramps, trembling, incontinence of urine, nocturnal frequency of urination, premature age, lead deposit in gums, arteriosclerosis, incoördination, absent wrist reflexes, dermographia, lead in urine, atypical blood-smear pictures, decreased percentage of hemoglobin, increased red-blood cells, resistance to hypotonic salt solutions, weakness in wrist extention, and high pulse pressure.

5. *Strength of Wrist Extension.* This was determined also by the dynamometer. The subject was requested to sit in an arm-chair, first with hand passively flexed over forward end of the arm of the chair, when, with a wet towel folded up and placed on the dorsum of the hand to keep instrument from causing pressure pain to the hand, and also to prevent its slipping, the subject was asked to raise his hand up against the examiner's resistance on the dynamometer (active resistance). This gave one reading, the minimal for which was ascertained as not less than 30 with normal men. Secondly, the subject was requested to support his forearm on the arm of the chair, with hand extended free in the air, the wet towel applied as before, after which the examiner, with instrument in hand, forced the subject's hand to flex downward against his passive resistance. This gave a second reading, the minimal for which was ascertained as not less than 35 with normal men.

The results with painters showed:

Active resistance below normal in	16 of 96	cases in	both	wrists
" " "	20 of 96	"	right	"
" " "	22 of 95	"	left	"
Passive " "	7 of 81	"	both	"
" " "	13 of 81	"	right	"
" " "	20 of 81	"	left	"

It is worthy of note that these painters were relatively stronger in the left hand and forearm, the one least used, than in the right; also that weakness in grip (prehension) was much more frequent and pronounced than weakness in wrist extension. These facts tend to support Edinger's exhaustion theory that fatigue determines the localization of the effects of plumbism: the painter has a constant, firm grip upon his brush, while wrist movements are second, upper arm movements third, and elbow movements fourth in order of use. In acute lead paralysis it appears that the wrists are affected most and the upper arms second, therefore corresponding to range of movement in neuromuscular effort; but it appears from these tests that weakened prehension, not necessarily paralysis, is always an associated and probably the earliest condition.

6. *Blood-pressure.* This was determined with a mercury manometer (Mercer type) applied to the right arm, with the subject in a sitting posture, using the stethoscope applied to the cubital fossa to interpret the results. By this means the systolic pressure was first taken, then the diastolic, after which the patient was requested to perform a uniform exercise; namely, that of bending forward, if possible to touch the toes, and rising erect ten times. Thereafter he seated himself at once in the chair at the instrument and pressures were again determined.

Results. *Systolic Pressure:* Before exercising, and taken toward the end of the examination in each case so as to eliminate the psychical factor as much as possible; also after the patient had seen the preceding case so examined when possible. The cases ranged between 98 and 204 mm. Hg. as follows:

Not over 100	mm. Hg. in	3 cases.
Between 101 and 120	"	39 "
Between 121 and 130	"	17 "
Between 131 and 140	"	17 "
Between 141 and 150	"	12 "
Between 151 and 160	"	6 "
Over 160	"	6 "
Total		100 "

From the above it will be seen there were 41 cases in which the systolic pressure was 130 or above (meaning an unfavorable prognosis, according to Blum[5], if continuously so, and implying contracted kidneys). However, if we take Johnston-Lavis'[6] observation that the systolic pressure should not be over the number of years of age plus 100 for adults—there were 19 cases abnormal. Of these 19 cases, 16 had a significant disqualifying history: syphilis (2), excessive coffee drinking (4), excessive alcoholic consumption (8), valvular heart disease associated with inflammatory rheumatism (2).

[5] Medizinische über die Bleivergiftung. Deutsch. med. Woch., April 4, 1912, xlviii, No. 14. Blum also advises absolute prohibition from the trade if blood-pressure is continuously above normal.

[6] Sphygmomanometry and Pachon's Oscillometer, British Med. Jour., January 13, 1912, No. 2663, p. 72.

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Thirty-five cases in which systolic blood-pressure was 132 mm. or over showed significant association as follows:

1. Age, 10 of 20 cases over fifty years old.
2. Time at trade, 12 of 22 cases over thirty years at trade.
3. History of encephalopathy, 4 of 5 probable cases.
4. Alcoholics to excess, 21 of 27 cases.
5. Arteriosclerosis (radial), 8 of 11 cases.
6. Wrist reflex absent, 2 of 2 cases.
7. Abdominal reflex absent, 10 of 12 cases.
8. Knee-jerks absent, 3 of 3 cases.
9. "Gouty" great toe-joint, 6 of 8 cases.
10. Albumin and casts, 5 of 7 cases.
11. There was also associated too great a relative proportion of the following complaints and afflictions: History of plumbism, history of "triad," history of rheumatism, history of coffee excess, loss of weight, vomiting, constipation, diarrhea, visceralgia, distention of abdomen, headaches, depression, poor memory, joint pains, muscular cramps, "rheumatism," tinnitus aurium, urinary and circulatory disturbances, premature old age, pyorrhea, tremor, incoördinations, heart disease or enlargement, hernia, absent cremaster reflex, lead in urine, atypical blood-smear pictures, increase of red-blood cells resistance to hypotonic salt solutions, decreased percentage of hemoglobin and weak hand grips.

Diastolic Pressure. This varied from 62 to 112 mm. with 15 cases over 90 mm.; 14 of these higher diastolic pressures occurred in cases with abnormally high systolic pressures.

Pulse Pressures. This varied between 30 and 97 mm. There were 79 between 35 and 60 mm. There were 8 over 60 mm., all occurring with high systolic pressure. There were 13 under 35 mm., all occurring with low systolic pressure.

Systolic Pressure after Exercise. Rose from 1 to 30 mm. in 91 cases; remained the same in 5 cases, and dropped in 4 cases.

Diastolic Pressure after Exercises. Rose a few millimeters in 8 cases; remained the same in 74 cases; dropped a few millimeters in 17 cases. However, there is no apparent relation between these slight variations and the pressures previously noted, nor with any particular group of symptoms.

Of the total of 100 men, 83 were examined in the afternoon, 12 in the forenoon, and 5 in the early evening.

Although blood-pressure determinations of one sitting cannot be given too much reliance, still the fact that in fully one-third of the cases the findings were at or above the upper limit of normality has some significance. This is particularly so when we take into consideration the report of Mr. John A. Runnberg, the statistician of this same union, issued March 1, 1913, from which I quote:

"A recent investigation as to the causes of death of 100 members during the last four years, reveals the fact that the five great causes of death are organic heart disease, pulmonary tuberculosis, nephritis, pneumonia and accident at work. Almost one-fourth of all deaths are due to some disease of the circulatory system, of which organic heart disease alone exceeds the general death-rate of the city by about 32 per cent. The investigation further shows that the average age at death from any of these five causes is from two to seven years less than the corresponding death-rate in the city at large."

SUMMARY. Of 100 painters examined under favorable conditions: (*a*) Definite symptoms of acute plumbism could not be said to obtain in any case. There were no acute abdominal or nervous cases, none showing erythrocytic basophilia in significant amount (that is nothing approaching 1 per cent. of the total number of red cells). However, 2 cases, gave a positive Liebermann hemolytic resistance test and 2 others exhibited lead in the urine, and there was a suggestion of traces in others. (*b*) Symptoms, signs or after-effects of chronic plumbism of varying degrees, after eliminating other factors, so far as possible, were found in a total of 70 cases. It is not easy to summarize these records, but they fall failry well into the following groups:

Group 1 (history, symptoms, physical signs, tests). Includes 19 men who gave a clear history of previous lead poisoning, 12 of a history suggestive of lead poisoning, 7 were suffering at the time from symptoms clearly indicative of chronic plumbism, and who, in addition, exhibited physical findings and abnormal results in one or more of the tests described above (not including the sodium sulphide test). Average age, 46.16 years, and time at trade 28.15 years. Only 4 were under forty years and 1 over sixty years of age.

Group 2 (history, symptoms, physical signs). Includes 16 men; 7 with a clear history of plumbism and 9 with a suggestive history. All were suffering from symptoms ascribable to chronic plumbism, and were found by physical examination to have systemic diseases ascribable to chronic toxemia. Special tests were negative or borderline only. Average, 34.56 years, and time at trade 16.75 years. Only 3 were over forty years.

Group 3 (history, symptoms, tests). Includes 7 men; 3 with a clear history and 4 with a suggestive history of plumbism, complaining of typical symptoms and responding positively to one or more tests. Physical findings negative or in abeyance. Average age, 40.43 years, and time at trade 25.14 years. Decade distribution uniform.

Group 4 (symptoms, physical signs, tests.) Includes 12 men who had no history of former attacks, but who were at the time suffering from typical symptoms, and who had positive physical findings and responded abnormally to one or more tests. Average age 43 years, and time at trade 23.75 years. Decade distribution uniform.

Group 5 (history, physical signs, tests). Includes 5 men; 2 with a clear and 3 with a suggestive history of lead poisoning; not complaining of ill health, but with physical signs pointing to chronic plumbism and with abnormal response to one or more tests. Only 1 under fifty years (a man aged 40 years). Average age, 51.40 years, and time at trade 32.20 years.

The following 11 cases are less distinctive, but must be looked upon as suspicious:

Group 6 (history, symptoms). Five men whose history was suggestive and who complained of more or less typical symptoms, but physical findings and tests were without material significance.

Group 7 (history, tests). Two men had a history of former attacks and had marked weakness of the wrists but an absence of recent symptoms, also other abnormal physical findings.

Grooup 8 (lead line). Two men showed lead deposits in the gums as the only acceptable manifestation. Alcoholism probable cause of other features.

Group 9 (pyorrhea, weak wrists.) Two men showed pyorrhea and weak wrists only. There was an absence of suggestive history, symptoms, and other features.

With the above groups of workers, age and time at trade have nearly equal curves. Analysis of the four means of arriving at a diagnosis (history, symptoms, physical signs, and special tests) shows:

(*a*) In the younger men (under forty years the tests above described are most apt to fail, while history, symptoms, and certain physical signs are usually present (Group 2).

(*b*) Among middle-aged men (forty to forty-five years) there is a small group (a part of Group 3) which fail to show significant physical signs while the other features are present.

(*c*) A fairly large class (Group 4) composed of men of all ages gave no significant history.

(*d*) Among men over middle age, forty-five years and above, there is a large class (Group 1) showing evidence of every sort indicative of chronic plumbism.

Among the 30 remaining cases were many with suggestive findings, but the preponderance of secondary factors caused them to be eliminated. These cases were as follows:

One each of diabetes, syphilis, tabes (?), Graves' disease (?), hyperchlorhydria, migraine (since childhood in a young man whose blood-pressure was 145), and senility; 6 cases of cardiac or circulatory disease; 8 negatives; and 9 indefinites.

Conclusion. Seventy of 100 painters showed evidence of chronic plumbism. The most frequent factors of value in diagnosing chronic plumbism in painters are:

(*a*) Significant past history of certain complaints as noted above.

(*b*) Frequency of certain recent symptoms as noted above.

(*c*) Neuromuscular abnormalities—as tremor, slight incoordinations, abnormal reflexes, weakened hand-grip, and weakened wrists.

(*d*) Circulatory disturbances affecting the blood-pressure, the heart, and the urine.

(*e*) Conditions of the gums—pyorrhea, rarely lead-line.

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FATAL GASTRO-INTESTINAL HEMORRHAGE.

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Sudden gastro-intestinal hemorrhage is fortunately not a common cause of death. Hemorrhage is sometimes the fatal termination of enteric fever and other diseases, but the sudden occurrence of gastric and intestinal hemorrhage with those in the enjoyment of practically good health is one of the most alarming incidents in the work of a surgeon or physician. In presenting the following cases, we have excluded those which were considered due to the commoner causes of hemorrhage, such as ulceration of the stomach or bowel, aneurysms rupturing into the tract, blood disorders, or malignant disease. Neither did we include those fatal cases, in which the clinical signs indicated an unusual etiology, but in which no confirmatory postmortem examination was obtained.

Case I.—A. L., male, aged thirty-three years, was admitted to Dr. Armstrong's service at the Royal Victoria Hospital October 18, 1912. The patient left Toronto on the night of October 17, 1912, perfectly well. After eating a hearty breakfast in Montreal he was suddenly seized with vomiting, and emitted a basinful of